Jan. 2, 1934. H. L. CROWLEY 1,941,661

ELECTRON DISCHARGE DEVICE

Filed Sept. 14, 1929

Fig 1.

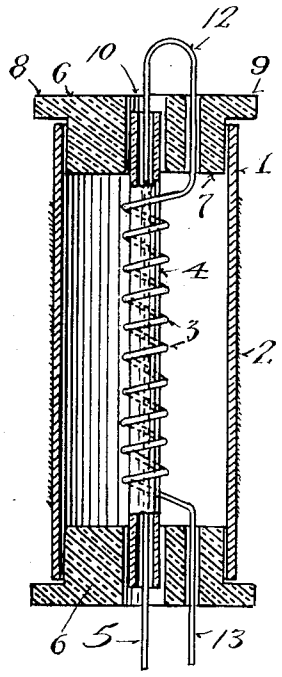
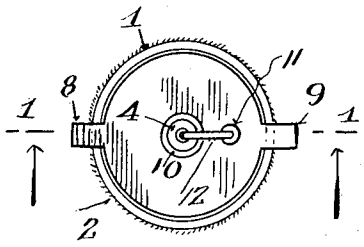


Fig 2.



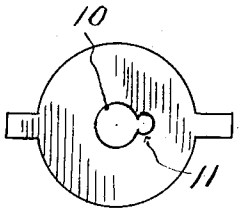


Fig. 3.

Fig 4.

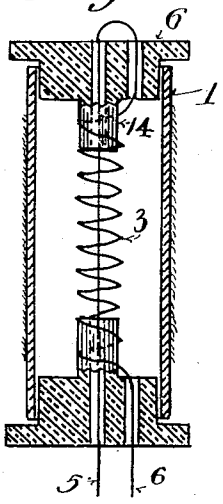
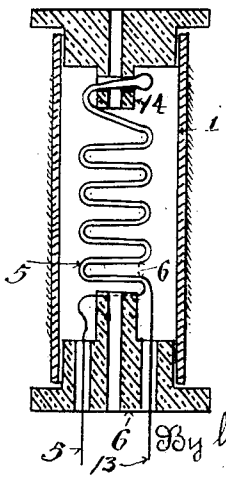


Fig. 5.



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UNITED STATES PATENT OFFICE

1,941,661

ELECTRON DISCHARGE DEVICE

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Application September 14, 1929
Serial No. 392,538

3 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices, and with particularity to an improved electron emitter construction for such device.

An object of the invention is to provide an improved electron emitter of the indirectly heated type.

Another object of the invention is to provide an electron emitting cathode of the indirectly heated type having a more rigid construction than has been attainable heretofore.

Another object of the invention is to provide an indirectly heated cathode for electron discharge devices capable of being heated by alternating current with a minimum of disturbance from the alternating current source.

A feature of the invention relates to an electron emitting cathode suitable for use in electron discharge tubes and having a novel assembly and construction of parts whereby microphonic noises in the tube, as well as the occurrence of short circuits between the heating system and the electron emitting system are materially reduced. As a result of this feature there is enabled to be produced a tube which has improved operating qualities and is capable of highly uniform characteristics.

Another feature of the invention pertains to an indirectly heated cathode employing a so-called concentrated or coiled filament heater, and disposed within the cathode structure so as to prevent interaction between the electron stream and alternating field, due to the filament current.

A further feature of the invention resides in a novel cathode construction which is economical of manufacture, simple of construction, and in which the heat-lag characteristic is reduced to a minimum.

A still further feature relates to the organization and arrangement of elements which go to make up a highly efficient electron emitter.

Other features and advantages not specifically enumerated will be apparent after a consideration of the following description and the appended claims.

While the invention will be described hereinafter as applied to certain specific embodiments, it will be understood that the invention in its broad aspects is capable of other embodiments.

Figure 1 of the drawing shows a vertical view in section of one preferred embodiment of the invention;

Fig. 2 is a top plan view of the structure of Fig. 1;

Fig. 3 illustrates a modified form of cathode closure and spacer element according to the invention.

Fig. 4 shows a modification in which the end closure and filament support rods are integral and the rods extend only part way into the cathode sleeve.

Fig. 5 shows a modification of Fig. 4 in which the filament is double-wound.

Referring more particularly to Fig. 1 of the drawing the numeral 1 represents a hollow metal member, preferably cylindrical and formed of iron, nickel, tungsten, or any other suitable material. Said member 1 may be formed from seamless tubing, or it may be made in the form of a helically wound strip of metal. The external surface of member 1 is provided with a coating of any suitable electron emitting material, and preferably this coating does not extend completely to the ends of the cylinder 1. For the purpose of rendering the coating 2 electronally active there is disposed on the interior of member 1 a heater element 3 in the form of a wire, which is wound in helical fashion around an insulator rod 4, said rod having a bore extending longitudinally therethrough, and through which passes the return end 5 of the filament 3. Tube 4 is made from high temperature or refractory insulating material and preferably of the composition disclosed in the copending application of Henry L. Crowley, Serial No. 332,555 filed January 14, 1929. In order centrally to locate the heater element and the tube 4 within the cylinder 1, there is provided at each end of said cylinder a closure member 6, formed also of refractory insulating material, preferably of the same composition as the tube 4. Each of the members 6 has a main circular body portion 7 adapted to fit internally within the end of the cylinder 1. Members 6 are also provided with laterally extending lugs 8 and 9, which are adapted to abut against the edge of cylinder 1. The members 6 are provided with centrally located bores 10 to receive the ends of the insulator rod 4, whereby said rod is accurately and centrally positioned within the cathode assembly. Centrally offset bores 11 are also provided in members 6, to receive the reversed loop portion 12 of the heater element 3.

While it is preferred to maintain the closure members 6 in position by a frictional engagement or tight fit within the cylinder 1, the upper member 6 may be retained in position by means of the loop portion 12, and similarly the lower member 6 may be retained in position by bending the ends 5 and 13 of the filament laterally.

Similarly the tube 4 may be closely fitted within the bores 10 in order to maintain it centrally or if it is desired to employ a loose fit between the tube 4 and the members 6, the said tube may be maintained in central position by relying on the rigidity of the filament which may be conveniently adjusted in centering said tube.

As a result of this construction it will be seen that the heater element is at all times maintained in a symmetrical position with respect to the cathode coating 2, so that any changes in expansion will not produce unequal variations in the heat transmitted to the coating 2. Furthermore since the heater filament 3 is in the form of a coil a more efficient heater is provided than when a single straight wire is employed. While coiled heater elements have been used in cathode structures heretofore considerable difficulty has been encountered in maintaining uniformity of heat radiation to the cathode. By means of the tube 4 around which the heater 3 is wound, and as a result of the accurate positioning of the tube 4 within the cylinder 1, these unequal heat radiating effects are entirely avoided. Furthermore as a result of the reverse looping of the filament through the central part of tube 4, the filament as a whole presents little or no external magnetic field to affect the cathode coating since in effect it is a non-inductive circuit. Furthermore, because of the accurate fit between the members 6 and the cylinder 1 and between the tube 4 and the member 6, a more rigid construction is provided than is the case where a straight filament or an unsupported coil filament is employed. As a result of this rigid construction the cathode is less susceptible to microphonic vibrations or disturbances. Likewise, because of the manner of winding and supporting the heater filament, the likelihood of short circuits within the cathode structure are substantially eliminated. If desired the rod 4 may be notched or grooved to insure a proper spacing of the turns 3.

Fig. 3 shows a modified form of cathode closure member similar to the member 6 of Figs. 1 and 2. In this modification however the insulator members are provided with a central bore 10 and the inner wall of this bore is also grooved as indicated by the numeral 11, to receive the looped portion 12 of the heater filament. In effect therefore a single bore is provided, made up of a large central portion and an offset lateral portion. Consequently such an insulator member with both bores may be readily formed by an extrusion process such as disclosed in the application referred to hereinabove.

While the member 6 and the tube 4 of Fig. 1 may be formed by any suitable mechanical process, it is preferred to manufacture them by the extruding process referred to in said application of Henry L. Crowley, since such a process enables these relatively small parts to be manufactured with a high degree of uniformity and with a minimum of breakage during the extruding process. For example, employing the extruding process, it has been found that the tubes 4 may be made as small as .015'' internal diameter, and .040'' outside diameter.

Referring to Fig. 4 there is shown a modified form of the insertion in which the end closure members for the cathode tube 1 are provided with integral tube-like extensions 14 which extend only partly into the cathode sleeve 1. The filament 3 is wound around the extensions 14 in a manner similar to the winding in Fig. 1. However, it will be noted that the filament is freely supported in the space between the opposing extensions 14. While the extensions 14 are shown in Fig. 4 as extending about one-quarter of the length of the sleeve 1, it will be understood that they may extend a greater or less extent as is found desirable. For example they may be made sufficiently long to abut against each other when assembled on the ends of sleeve 1, thus in effect providing a single continuous support for the filament. If desired the extensions 14 may be just sufficiently long to center the filament turns, thus allowing the major part of the filament to be freely supported within the cathode sleeve. It is clear that instead of making the extensions 14 integral with the portions 6, these extensions may be in the form of small rods firmly attached to the members 6, for example by a tight fit within the bores 10 or in any other suitable manner.

Referring to Fig. 5 there is shown a modification of Fig. 4 in which the filament is in the form of a double winding, preferably non-inductive and in which the ends 5 and 13 are brought out through the same insulator member 6. In this modification the filament may be provided with an insulating coating to prevent short circuiting between turns.

While specific materials are disclosed herein, it will be understood that the broad aspects of the invention relate to the manner of assembling and positioning the cathode heater within the cathode assembly, together with the means for preventing interaction between the heater field and the electron emitting field. Accordingly various changes may be made in the designs and proportioning of the individual parts without departing from the spirit and scope of the invention.

I claim:

1. An electron emitter comprising a hollow member having a coating of electronically active material, an insulator rod projecting centrally into said member, and a coiled heater element having a portion only of its length supported by said rod, the remainder of said coil being freely supported, said rod being provided with a bore for receiving a portion of the heater element.

2. An electron emitter comprising a hollow member having a coating of electronically active material, an insulator plug fitting in the end of said member, radial lugs on said insulator of limited circumferential extent, an apertured central lug on said insulator extending into said member and laterally spaced from the interior wall of said member, and a heater element supported in the apertured central lug.

3. A cathode, comprising a hollow tubular member having an outer electron emitting surface, insulating plugs at each end of said member, one of said plugs carrying a central projecting portion, said portion extending only a part of the distance between said two plugs and being supported solely by the plug from which it projects a helical filament within said tubular member, one end of said filament surrounding said central projection, and means on the other of said plugs for supporting the other end of said filament, said parts being so arranged that the filament is supported out of contact with said member to provide a free annular space around the filament.

HENRY L. CROWLEY.